Tell us about your Model!

THE MODEL ENGINEER

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In this issue

This interesting picture of the pit-head buildings of the Levant mine, near St. Just, Cornwall, was taken by Mr. A. J. Fellows, of Polegate, on September 21st, 1931. The previous day the beam engine, housed in the centre building, ceased work, aged 110 years ; it was still in first-class order and ready for re-use. It had a cylinder 40 in. bore with a stroke of 7 ft. in the engine and 6 ft. in the shaft. The mine yielded tin, chiefly, but small quantities of copper were also obtained. The engine was steamed by two Cornish boilers at 40 lb. pressure.

THE MODEL ENGINEER

Vol. 87 No. 2161

Percival Marshall & Co., Limited
Cordwallis Works, Maidenhead

October 8th, 1942

Smoke Rings

Power-boating at Marblehead

A RECENT letter from Commander Parker H. Kemble, of Marblehead, U.S.A., reports considerable activity among local power-boat enthusiasts. Incidentally, he tells us that no less than sixteen hydroplane hulls have been built to the 24-in. design by Mr. E. T. Westbury, published in THE MODEL ENGINEER for May 18th, 1939, and succeeding issues. Fitted with 7½ c.c. engines these boats have already recorded speeds of over 20 m.p.h. and, with further experimenting in progress, still better results are looked for in the near future.

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Organising the Amateur Workshop

THE recent series of articles by Mr. Ian Bradley under the above title was packed full of practical hints on the equipment of a workshop and its best arrangement. Mr. Bradley tells me that he has a small overflow of hints which he proposes to incorporate in a supplementary article in the near future. Some of these hints have been kindly supplied by readers who have been interested in Mr. Bradley's articles, and he now writes to say that he would be very pleased to hear from other readers who may have some useful ideas to contribute to the common pool of knowledge. I shall be pleased to forward any such workshop items to Mr. Bradley, together with any comments which readers may be disposed to make on the utility of his previous suggestions or alternative methods of achieving the same results.

. . . ——

Feathering Paddle Wheels

A FEATHERING paddle wheel is an interesting piece of mechanism in any size, but when the working parts have to be incorporated in a wheel only 2½ in. in diameter much ingenuity and neat workmanship are called for. Mr. Victor Harrison, who desired to make a pair of such wheels for one of his flotilla of model ships, was informed that it was not a practical proposition and much too complicated a job for him to tackle. But the critic did not know Mr. Harrison's skill and determination in these matters, for he has succeeded in building two feathering wheels of this size. He writes me :—"I have come across no insurmountable difficulties, and the wheels seem of ample strength to withstand all working conditions. It is simply a case of keeping on plugging away to achieve the result. In the wheel itself there are actually 72 separate parts." That phrase, "plugging away," reflects the true model engineering spirit. Difficulties exist to be overcome.

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Power-boating up North

I HAVE been pleased to hear once again from our friend Mr. T. R. Barnett, of Whitley Bay, whose articles on "Power-boating up North" were such a popular feature of THE MODEL ENGINEER in peacetime. Mr. Barnett sends me another chapter of the doings of the Tynemouth Model Yacht Club, with photographs, which I hope to publish at an early date. This time the "doings" relate to a special power-boat competition held in July last, in connection with the local "holidays at home" gatherings. An unusual feature of this display is that it was held at the special request of the local Council, who also undertook to supply the prizes. Here is a welcome official appreciation of the recreative value of model power-boating which is in marked contrast with the strange apathy of the authorities at Manchester and Birmingham. Tyneside has always been a "hot-spot" in the power-boating world, and I am pleased to learn that in spite of the preoccupation of members with more serious wartime duties, their enthusiasm for their models needs only a spark of encouragement to set it fully ablaze again.

Percival Marshall

The Holcroft 4-to-2 Valve Gear

By "L.B.S.C."

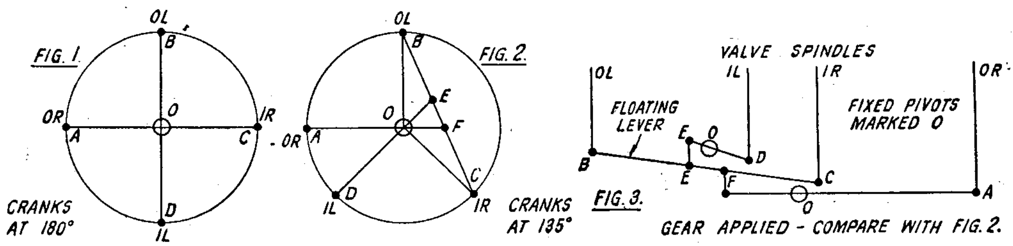
FREQUENT reference is made in correspondents' letters to "Tugboat Annie" and her valve-gear, and many good folk are worrying for a full description of her, with detailed drawings. Well, the trouble is that I built "Annie" without a solitary pencilled line of my own, the only drawing used being that furnished by Mr. Holcroft for his wonderfully ingenious conjugated valve-gear for operating the valves of the inside cylinders; and even that was only a general arrangement plus a rough tracing of the levers giving the suggested dimensions. There are only 24 hours in the day, and poor Curly is finding it harder and harder to squeeze into the waking part of them all that is required to be done; and up to the present I have found it absolutely impossible to make the necessary drawings so that I could give full instructions for building similar engines to "Annie." Although I do not need drawings for my own work—if I did, I'd never get anything done at all!—I cannot very well explain in these notes how to do a job, unless it is accompanied by illustrations; so there, you good folks who "want to know why," have the whole truth of the matter, and I crave your indulgence and sympathy. However, there is one thing that I *can* do, and that is, to give a drawing and short description of the "four-to-two" conjugation, so that anybody who so desires, could fit it to any four-cylinder locomotive of similar dimensions to "Annie"; it could also be easily adapted to any existing "Pacific" or 4-6-0, by putting in another pair of cylinders to drive the leading coupled axle, and setting the cranks at 135 deg. It does not matter whether the outside valves are operated by Baker, Walschaerts or any other gear; the action of the conjugation is exactly the same.

Mr. Holcroft's Explanation

Although "Tugboat Annie" is the first engine, big or little, in the wide world, to be fitted with a "four-to-two" conjugated valve gear, and to the best of my knowledge and belief is the only example of her kind, the idea is now 22 years old; for back in 1920, Mr. H. Holcroft read a paper on "Four-cylinder Locomotives" before the Institution of Locomotive Engineers, in which he described all the types then in existence, or which had been tried out, and gave details of his own devices. He dealt with various Continental, Colonial and American four-cylinder drives—Vauclain compounds, French and Belgian Pacifics, the G.W.R. 4-6-0s and so on, describing the various forms of vertical and horizontal rocking shafts, and the different connections to the inside and outside valve spindles, explaining the action as follows. I quote his own words from his paper:—

"In a four-cylinder engine with cranks at 180 deg. the rocking levers can be represented geometrically as in Fig. 1. A circle is drawn with centre O to indicate the valve travel, and four points are taken on the circumference 90 deg. apart at A, B, C, and D. The motion of the valve-gear can be replaced by an equivalent crank, so that the four points represent four valve motions, outside right, outside left, inside right and inside left respectively. Join A C and B D; then A O C and B O D are two rocking levers pivoting on the engine frame at fixed points. If either the two inside or two outside valves are driven by ordinary valve-gears, the remaining two can be operated through simple rocking levers attached to them.

Now in Fig. 2, one pair of cranks are moved around through an angle of 45 deg. so as to give eight impulses per revolution,



Mr. Holcroft's explanatory diagrams.

the same lettering as in Fig. 1 being used. In order to form one system of levers, join B C, draw A O F cutting B C at F, and D O E cutting B C at E. The mechanism will therefore consist of a rocking lever, A O F, attached to the outside right valve at A, pivoted to the frame at O, and attached to a floating lever, B E F C, at F. The latter is attached to the outside left valve at B, and to the inside right valve at C. In order to operate the fourth valve, the rocking lever D O E is attached to the inside left valve at D, pivots on the frame at O, and connects with the floating lever at E. The proportions of the various levers are as shown by the diagram, but may be made of any proportionate length. The corresponding mechanism is set out diagrammatically in Fig. 3, and it will be seen that by the addition of one lever only, the two valve-gears may be made to operate four valves when the main cranks are set at 135 deg. instead of 180, there being three levers in place of two."

Mr. Holcroft then went on to say that there was another way of getting a similar result, by using a separate combination to operate each inside valve-spindle, and superimposing the two combinations on one another; and it is the latter type of gear that is fitted to "Tugboat Annie." When he first saw my "Caterpillar" goods engine, which has four cylinders and 135-deg. cranks, he said that a simple arrangement of levers as described above could be applied to it. However, the nigger in the wood-pile was that the inside cylinders are "upside down," as the kids would remark, and the original arrangement of Holcroft gear called for all valve-spindles in the same plane. I therefore abandoned the idea of fitting the gear to that engine, and decided to fit one to the next four-cylinder job, arranging the valve-spindles all in line.

A Tight Squeeze

One of my pet fads, fancies, notions or whatever you like to call it, for an ideal four-cylinder locomotive, is that both inside and outside "works" should be as nearly as possible similar; that is to say, same length of cylinder blocks, guide bars, connecting rods and so on; especially with regard to moving parts, as this simplifies the balancing very considerably. Therefore, when I built my "answer to the driver's prayer" (in the "flesh," mind you; not on paper, or by proxy) I followed out this system; and as the drive is divided, the cylinders were arranged *a la* Great Western practice, the outside pair being set over the rear bogie wheels to drive the middle coupled axle, and the inside pair set ahead to drive the leading coupled axle. The valve-gear for the outside cylinders worked in very nicely, the Baker

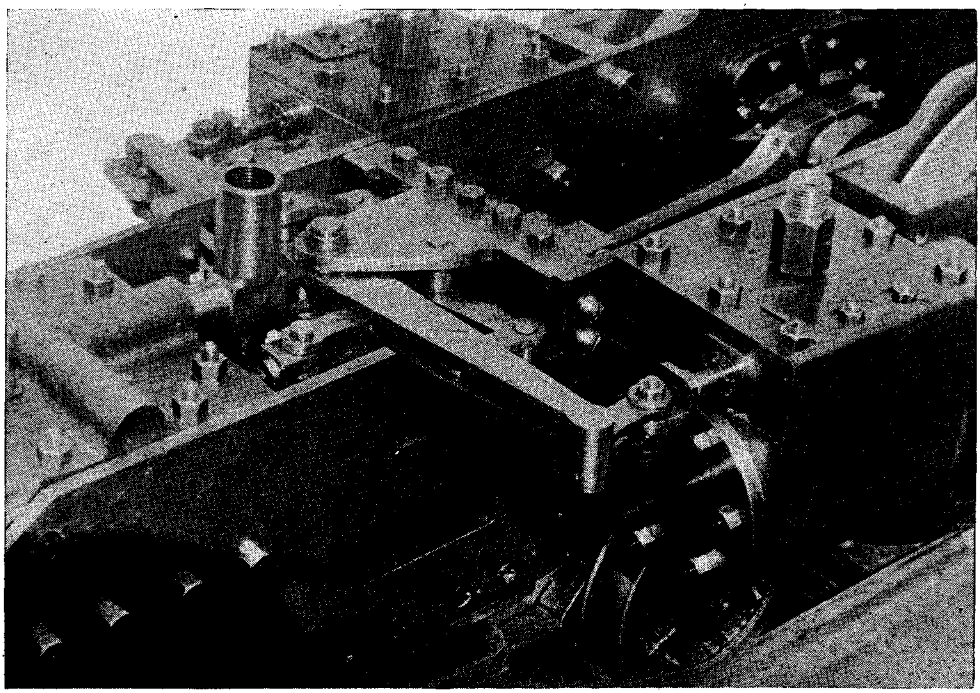
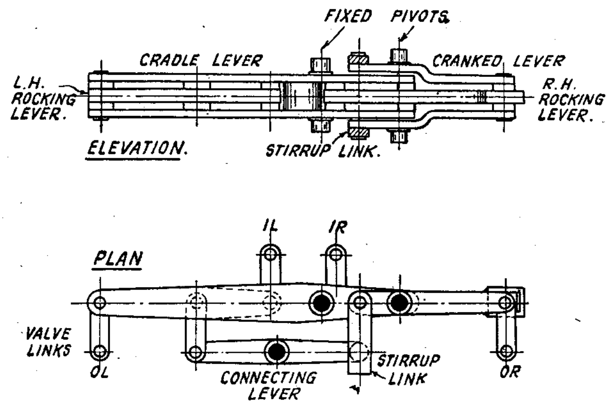


Photo. by] **The Holcroft gear on "Tugboat Annie."** [*C. J. Grose*

sets being adaptable to any type of engine, as either a girder or bracket frame can be used as is found most convenient. I used the girder frame, bracketing the rear end direct to the frame behind the coupled wheel, and fixing up a support ahead of the wheel which served both for the valve-gear frame and the guide-bar yoke. This arrangement, however, was not suitable for the original Holcroft assembly; and the only way to arrange the drive for the inside valves was by rigging up the conjugation to work in the same space usually occupied by plain rocking



Holcroft gear as applied to "Tugboat Annie."

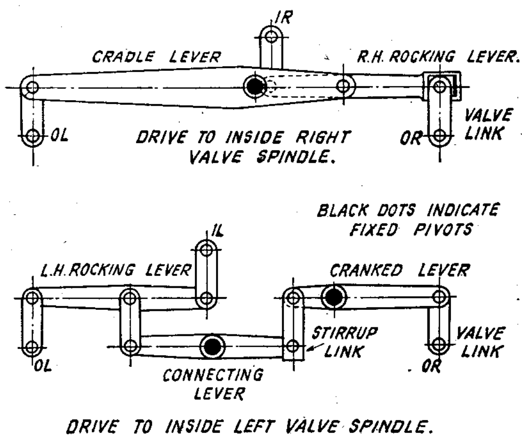
levers, as seen on the G.W. and L.M.S. four-cylinder engines. When I showed the chassis with the cylinders assembled to Mr. Holcroft, he said it was certainly going to be a tight squeeze, but he would get out something that would fit in; so I gave him a photograph of the chassis showing the cylinders in place, also a plan view of it, and he got busy.

I had every confidence that Mr. Holcroft would solve the problem, and he certainly did. I am going to say right here, and without fear of contradiction, that in your humble servant's estimation *and* that of a good many others, there is not another locomotive engineer in the whole wide world who can hold the proverbial candle to Mr. Holcroft when it comes to valve gear design.

It was not long before Mr. Holcroft telephoned to say that he had drawn out a suitable arrangement, and in due course he brought it along and explained all about it. He did the trick by using two overlapping combinations of levers. Each combination is actuated by *both* the outside valve-spindles, and the levers are very ingeniously superimposed, so that whilst they are all in the same plane, each set can operate quite independently of the other, without any chance of fouling. The accompanying illustrations show the complete assembly, also the two separate sections, so that the action can easily be followed.

How the Gear Works

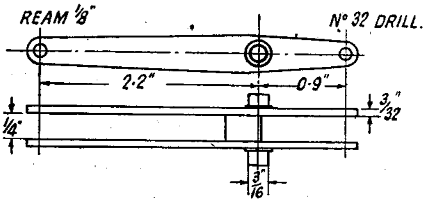
A short while ago I explained in these notes how the Gresley "two-to-one" valve-gear worked on a three-cylinder engine. Well, this one works on a similar principle; but as the cranks are set at 135 deg. instead of the 120 deg. of a three-cylinder engine, the centres and lengths of the levers are a little different. If you take a look at that half of the gear which drives the inside right valve, you will recognise immediately the long lever that corresponds to the long Gresley "two-to-one" lever on the three-cylinder engine; also the short floating lever coupled to the end of it, corresponding to the floating equal-armed lever on the Gresley gear. This one, however, isn't equal, for reasons mentioned above. Please note, I refer to the "Gresley" gear in a descriptive or distinguishing sense only. As a matter of fact, Mr. Holcroft anticipated Sir Nigel, and was the pioneer "conjugationalist." Now take a look at the second half. Here we have practically the same arrangement, but with the action reversed, the whole lot being "turned over," in a man-



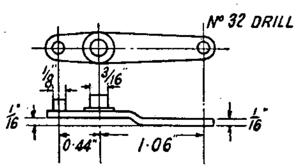
The two combinations shown separately.

ner of speaking. It would be mechanically impossible to use the same arrangement of long and short levers, and reverse the action by changing the fixed and moving pivots, as the levers would naturally foul, so Mr. Holcroft got over the trouble by an ingenious bit of "wangling," and killed all the birds with one shot.

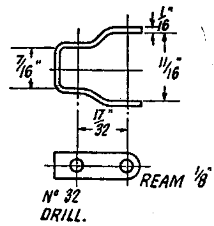
The long "Gresley" lever is all-present-and-correct-sergeant, but transferred to the right and rather shrunk in size although the proportions are O.K., and the floating lever is conspicuous by its presence on the other side, being practically the same size as its fellow-conspirator or opposite member; but the two levers, instead of being directly connected, are coupled by a third lever with equal arms, mounted on a fixed pivot to the rear of the main assembly. That leaves a gap on the horizontal line of the fixed and floating levers, which very nicely accommodates the fulcrum of the big lever. The combined movements of the outside valve-spindles on the outer ends of the levers produce corresponding movements of the inside ends which are coupled to the inside valve-spindles; and these movements are absolutely uncanny to watch. It looks as if the blessed gear itself had brains of its own, and *knew* just how and when to waggle the inside spindles back and forth. Though Mr. Holcroft explained the working of the gear to me, and I made it, yet I was fascinated beyond all measure when I got it erected and tried it on the air pump. The biggest shock I got was after I set the valves of the outside cylinders to my pet timing. I took off the cover of the inside steam-chest, took one look inside, and very nearly fainted. *The valves were already set*—the gear had done it!



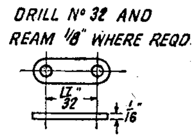
Cradle lever.



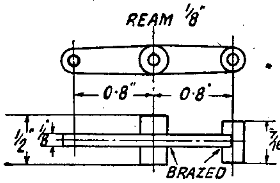
Cranked lever.



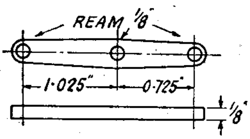
Stirrup link.



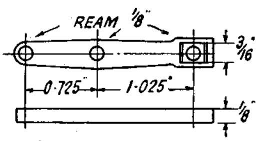
Valve links.



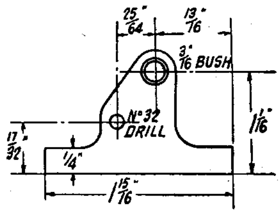
Connecting-lever.



L.H. rocking lever.



R.H. rocking lever.



Gear frame plate.

How the Gear was Made

The whole of the levers were cut from steel strip of requisite width and thickness; and the pins and pivots, which were a fixture, were made a press fit, so that the gear, when assembled complete, had a very clean appearance, and was entirely innocent of brazing marks, or excessively-rounded corners due to cleaning off burnt borax. The long cradle lever was made in two pieces, each ⅜ in. wide and 3/32 in. thick, drilled and filed to shape whilst clamped together. The distance-piece was turned from an odd scrap of ⅜-in. round steel left over from "Annie's" coupled axles. It was shouldered each end to fit ¼-in. holes drilled in the levers, the holes being very slightly countersunk. The piece was then pressed in, temporary pins being placed in the end pinholes to keep the levers in line; the projecting edges of the distance-piece were hammered into the countersinks and filed off flush, and the whole job polished on the linisher. The fulcrum-pins, which have a collar at the side next the lever only, were turned from ¼-in. silver-steel and pressed home under the ram of the bush and mandrel press which the late "Bro. Wholesale" gave me.

The right- and left-hand rocking levers, both of which float, were filed up from ⅛-in. by 5/16-in. strip, as they are single levers. The left-hand one has three plain pinholes in it, but the outer end of the right-hand one has a rectangular end with a slot in it, in which works a small bronze die-block. This is necessary because the lever works on a floating fulcrum-pin; and the end carrying the die-block works on the pin attached to the cranked lever which works

on a fixed fulcrum on the engine frame, so that the ends of the two levers describe arcs of different radii. The difference is very slight, but without the die-block we should stand a chance of what " Bert Smiff " would call " bustin' up the 'ole blinkin' works." Incidentally, " Bert " has been doing a bit of " bustin' up " himself at one or two places on the Continent. He said he would get his own back for certain broken windows, cracked ceilings, and missing tiles from the little South London home where he was born and raised, and he has certainly done it with interest. I'd dearly love to see " Bert " trying to get his womming-bird to lay a nice fat egg, fresh and warm, down Adolf's kitchen chimney — but I'll bet Adolf wouldn't !

The two cranked levers were cut from $\frac{3}{8}$-in. by 3/32-in. strip, and as the offset is the same as the thickness, the levers were simply placed between the vice-jaws with a piece of the same strip ahead of and behind the bend, and one good wrench at the vice screw-handle did the needful. The pins were turned from silver-steel rod and pressed into countersunk holes, riveted over slightly on the opposite side, and filed flush.

The connecting lever has two long bosses on it, so a spot of " brazing " was called for here. Holes were drilled at the correct centres in a piece of $\frac{1}{8}$-in. by $\frac{3}{8}$-in. strip, the two bushes turned up, and pressed in. A tiny fillet of Sifbronze flux mixed to a paste with water was laid around each ; then a touch with the oxy-acetylene blowpipe, using 75-litre tip, and a small bead of white Sifbronze was applied, and flashed into a fillet clean around each bush. The lever was then filed to shape and polished, and the joints are practically invisible. The lever looks as though it had been milled out of the solid.

The stirrup-link was made from a piece of 1/16-in. by $\frac{1}{4}$-in. steel strip very carefully bent to shape, and drilled after bending, extra care being taken with the marking-out. There are four pairs of small connecting-links needed for coupling up the gear to the valve-spindles, and these were filed up from $\frac{1}{4}$-in. by 1/16-in. strip, whilst the four little crossheads were made from $\frac{1}{4}$-in. square rod. All the straight pins are $\frac{1}{8}$-in. silver-steel ; those in the valve-gear are press fits in the levers in which they are a fixture, and work in reamed holes in the levers in which they move. The pins in the valve crossheads are made from the same material, but are shouldered down at each end and furnished with nuts and washers.

How the Gear is Erected

Two frame plates were cut out of 3/32 in. steel sheet, to fit between the engine frames, and these were fixed at a distance of $\frac{1}{2}$ in. apart by a piece of $\frac{1}{2}$-in. by $\frac{1}{4}$-in. brass rod, to which the frames were bolted by 3/32-in. bolts made from silver-steel of that thickness, screwed and nutted at each end. Each frame plate has a projecting tongue which is drilled and bushed to carry the pivots of the cradle lever. The pivot bush of the connecting-link works on a plain pin made a press fit in the frame plates. The whole issue is located at a point level with the front end of the outside cylinders, and is kept in position by two roundhead screws put through clearing holes in the main frames at each side, into tapped holes in the brass rod. The fixed pivots of the cranked levers are carried by two small steel brackets milled from $\frac{3}{8}$-in. square steel, and screwed to the right-hand main frame of the engine. The complete valve-gear assembly, frame and all, can be completely removed by disconnecting the small links from the valve crossheads, and taking out six screws. On a full-sized engine, the whole set could be changed by a fitter and mate with a hand crane, in a single night ; so that no engine fitted with a Holcroft gear need ever be laid up for repairs to it.

For the Bookshelf

Model Gliders, by R. H. Warring. (The Harborough Publishing Co. Ltd.). Price 4s. 0d. net.

The use of gliders has become a subject of interest to a large section of the air-minded public, though, in the field of model aeronautics, the subject has long held a prominent place in the activities of enthusiasts. This new book will be all the more welcome at the present time, since it deals comprehensively with the fundamental principles of the design, construction and flying of model gliders. Numerous photographs, diagrams and drawings enhance the utility of the book, which we cordially commend to the attention of all who fly model aircraft.

Aeroplanes in Detail. (London : The Temple Press Ltd.). Price 2s. 6d. net.

This is a portfolio of twenty-four perspective drawings by J. H. Clark, reproduced from *The Aeroplane*. It illustrates some well-known British, American and German machines whose names have almost become household words recently. The drawings contain a wealth of detail clearly shown, and, in addition, some striking photographs of the aircraft are included. The fundamental differences between British and German design are well portrayed, and the book should be of special interest to R.A.F. readers and A.T.C. cadets.

Force Feed Cylinder Lubrication

Notes on its Application to the "Midge" Locomotive

By GEO. GENTRY

THE oil feeding apparatus herein described is that devised and used successfully by Mr. G. S. Willoughby in his 7-in. gauge locomotives, and has also, it is understood, been fitted to certain 1-in. scale models in which he and his brother, Mr. Norman Willoughby, are interested. The general proportions of the oil pump, illustrated here by drawings, are as he advises, but the design has been slightly modified by the writer to facilitate, it is hoped, the making.

Fig. 1 is a layout, with details, of the spring-driven syringe pump, as mounted in the cylinder oil reservoir tank, which in itself is mounted fixed on the footplate at the controlling end. This is reproduced to scale of full size, the pump consisting of a 5/16-in. bore cylinder, equipped with a good-fitting plunger $\frac{3}{8}$ in. long, in one with its rod 3/16-in. diameter, around which, and taking its thrust against the top cover, is a 20-gauge 20-coil steel spring acting on the plunger piston. The handle knob at top, by which the pump is hand set, acts as a down stop on the top cover, and therefore makes the appliance semi-automatic in character. At the cylinder base, upon a bottom cover which is suction holed $\frac{1}{8}$ in., is mounted a 5/32-in. steel ball, acting as a suction valve, the extreme base of which, allowing for the driver cross slot, is to be at a minimum distance of 3/64 in. from the bottom inside of tank. At as low a level as possible, and upon a convenient side of cylinder, it is pierced to take a 5/64-in. holed elbow, looking upward, which is preferably to be silver-soldered into the cylinder. This elbow, holed vertically with No. 40 drill and tapped

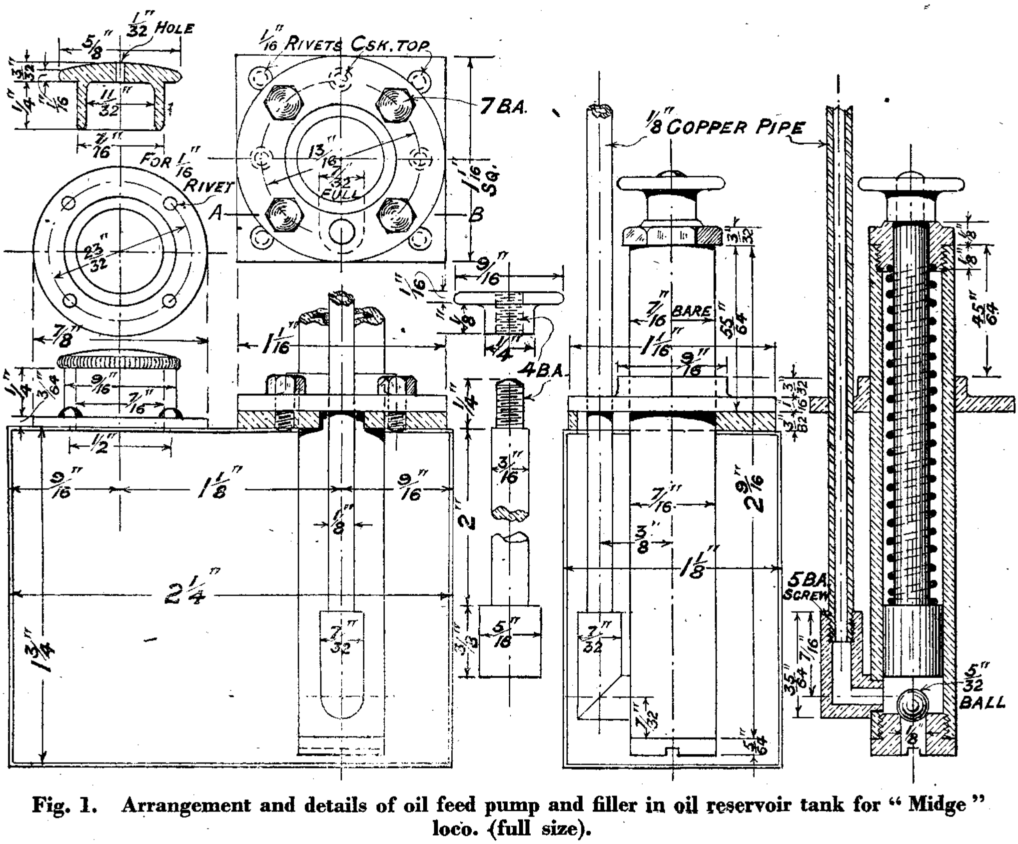


Fig. 1. Arrangement and details of oil feed pump and filler in oil reservoir tank for "Midge" loco. (full size).

No. 5 B.A. at the top, takes, screwed to it, a $\frac{1}{8}$-in. vertically placed copper pipe, set in parallel alignment all ways with the cylinder. This pipe is carried to such a height, curved over to the horizontal, and carried in such a direction as is suitable to fix to a back-pressure valve mounted on the smokebox, as will be seen later. Such copper or brass pipes are always sized by their outside diameters, and this one will be about 1/32 in. thick and, therefore, 1/16 in. in the bore. By the same sizing the pump cylinder body is proposed to be made in one piece of a length of 7/16-in. brass pipe, 16 gauge thick, which comes out, as drawn, to 5/16-in. bore about 3 " thou." undersize. At a given distance from the cylinder top a 1 1/16-in. diameter brass flange is fixed, holed for four No. 7 B.A. screw bolts, by which it is screwed to a square brass seating plate flush riveted to the top of the oil tank; but of this more later, except to point out that this flange is holed $\frac{1}{8}$-in. clear on the appropriate side to pass the $\frac{1}{8}$-in. oil feed pipe and so to steady it to the vertical.

Detail Drawings

The several views in Fig. 1 are described as follows:—The bottom left-hand is a longitudinal vertical section of the oil tank, showing the position of the pump to the right and oil filler on top to the left, both in elevation. Above the filler is a plan of its flange, and over that a section of its plug. Above the pump, the top of which is shown broken, is a plan of its flange and square seating under it. The latter is holed centrally, 7/16 in. full, to clear the pump body, but this hole is extended keyhole fashion, as indicated dotted, 7-32 in. full wide and long enough to clear the elbow of the delivery oil pipe. The seating plate is riveted to the top outside of the tank with seven 1/16-in. brass flush-top rivets, and is shown in edge section on the line *AB* in the view below. The centre view of the group is an elevation of the plunger and its lifting knob, broken in the rod, but fully dimensioned. Next to the right is a cross section of the tank, on the mid-line of the pump, showing the latter complete in elevation, fully dimensioned. The final view, to the right, is a complete vertical section of the pump and attachments, made in the same plane as the last view, but with the hexagon of the top cover shown across the flats.

In making the pump, choose a particularly straight piece of 7/16-in. × 16-gauge (or 1/16-in.) brass tube (drawn brass or gunmetal for preference, but note that the bore is fairly free from rings or striations) Cut it 2 9/16 in. full (i.e. 1/32 in. full) long, and chuck it truly with one end projecting the least the chuck depth will allow. Face off the end square and bore the inside to 11/32-in. diameter for a depth of $\frac{1}{8}$ in. Screwcut this 40 t.p.i. and size up with a $\frac{3}{8}$ in. × 40 bottoming tap. Before dechucking, recess the inner end of the thread slightly with the screwcutting tool and be particular to take off the burr on the 5/16-in. bore at the shoulder. Turn the job about in the chuck and do the same to the other end (making it the top end). In this case, however, be particular that the outside runs as truly as possible and projects not less than $\frac{3}{4}$ in. from the jaws. Further, face off the end before boring and screwcutting to a length of 2 9/16 in. Before dechucking, the outside must be skim-turned or file-turned to clear the tinned bore of the flange for a distance along of not less than 11/16 in., which bore size will be apparent in the following: Make the flange, which is to be soak-soldered on to the outside of pump body, from a piece of 3/16-in. planished clock plate, or such sheet-brass as has a similar colour to the brass of the body tube. Cut a square piece $1\frac{1}{8}$ in. across sides, and on one side scribe diagonal lines and dot out at their intersection. From this dot one must be able to scribe a 1 1/16-in. circle to fall within the sides. Chuck this, dot outward, held by about 1/16-in. in a four-jaw independent, and set the scribed circle running truly and the outer face running flat.

Machining

The corners can now be turned off nearly to the circle and up to the jaws and the front faced down to a boss, 9/16-in. diameter standing out 3/32 in. Drill through the centre $\frac{1}{4}$-in. and internally bore to 7/16-in. diameter, so that the 7/16-in. body tube will pass in an easy push-fit, but with no apparent shake. Scribe by turning with a point tool a 13/16-in. diameter circle on the face of flange, and, by means of any dividing appliance, either mark off four radial lines for the bolt-hole centres, or, if any drilling accessory be available, drill the four holes from the slide rest, using No. 39 drill. Take the job out of the chuck, rough saw off and file the remaining corners and set the job up by its front boss in a true S.C. chuck, so that the bore runs apparently truly, when the edge of the flange can be turned to size, and it can be faced off to correct thickness. If the bore does not show apparent truth in running, put the job on a true-running brass mandrel in the chuck, so that it drives on fairly tightly, and so turn it on the bottom face and finished edge. Before dechucking—in either case—scribe a circle exactly $\frac{3}{4}$ in. in diameter on the face and on this circle, exactly midway between any two adjacent bolt holes, drill a $\frac{1}{8}$-in.

clearing hole to take the $\frac{1}{8}$-in. copper oil tube an easy push-fit. This flange in hand, and held in pliers, lightly tin the inside face of bore and, while still hot, wipe round with a piece of cloth, soaked with Fluxite, on the end of a stick. It is this tinned bore that must clear easily the relieved portion of the tube where it is marked 7/16-in. bore in the drawing.

Turning attention to the cylinder, make a mark on outside of barrel 55/64 in. ($\frac{7}{8}$ in. less 1/64 in.) from the top edge and scribe a ring for placing the flange. Between this ring, but not quite up to it, and the shoulder where relieved, tin the outside of body. Well flux it and make the flange hot and drop it flange face downwards to the shoulder and tap it down into position level with the scribed ring. By this means it is not necessary to tin all the tube above its fixed position. If sufficient of the tank and its seating are made it will be possible to try the pump in position, which should come out such that the bottom edge of the barrel or cylinder (minus the bottom cover screwed in) should be $\frac{1}{8}$ in. from the bottom inside of tank. As soon as this is ascertained, the flange may be soak-soldered into position by holding it with the cylinder horizontal in a violet bunsen flame for about 5 minutes, turning it round slowly and taking care not to shift its position.

Elbow Position

The way to set the position for the elbow is to lay the cylinder on its side in a pair of vee blocks on a surface plate. Find the centre of the cylinder and set a scribing block to it. Then turn the cylinder in the vees and adjust for such a position that the scriber point stands level with the centre of the $\frac{1}{8}$-in. oil pipe hole in flange. Then scribe a line along the barrel and it is on this line that the hole for the elbow is to be drilled, 7/32 in. or a little more, above the bottom edge. The elbow and the pipe to fit it having been prepared, set the elbow in its drilled hole and bring the pipe down through its guide hole in flange and screw it in. Having ascertained that the pipe sets parallel, in both planes, with the cylinder, solder the elbow in the position so found. Mr. Willoughby directs that silver-soldering should be used in this joint, but the writer thinks that plumbers' soft solder should do if properly done. If, however, silver-soldering be adopted, it would be advisable to pin the flange with one screw (not right through the barrel thickness) to avoid its shifting position by conduction heat unsettling the solder joint. Also it is not easy to run a hard solder joint in yellow brass without running some of the brass when alloying takes place. If the cylinder tube and elbow be of gunmetal

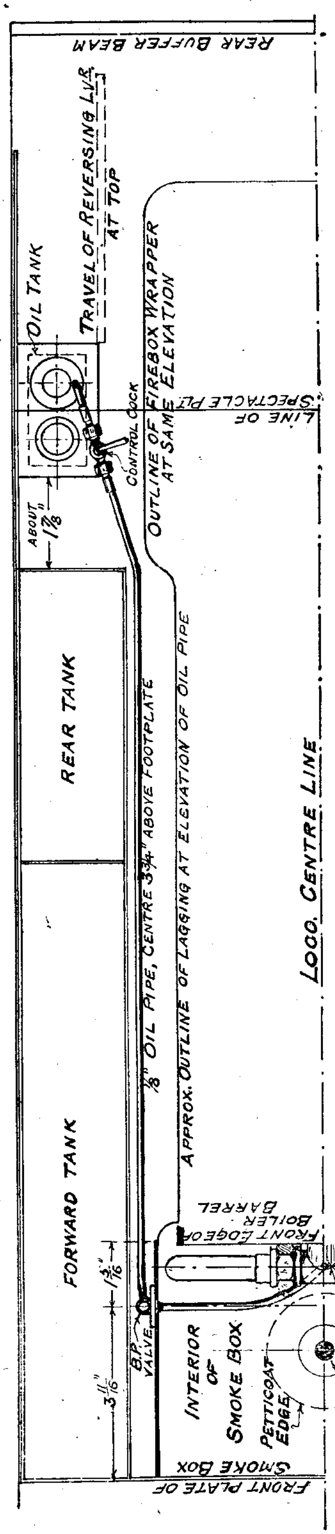


Fig. 2. Diagrammatic half sectional plan of "Midge," showing layout of oil feed to cylinders ($\frac{1}{4}$th full size).

it is a much easier matter to hard solder without disaster.

Lapping

Before soldering in the elbow, it would be as well to lap the bore of cylinder. Make a hardwood lap, shaped somewhat like the plunger ; that is, the piston portion to be turned 5/16 in. just to clear the bore and to be quite parallel, say, about $\frac{3}{4}$ in. long, the remainder being rather over $\frac{1}{4}$-in. diameter, to clear the bore well. In order to pass right through the bore of cylinder tube, which is 2 9/16 in. long from either end, set it in the chuck projecting about $2\frac{5}{8}$ in., large end outward. Then this length, plus about 1 in. in the jaws, makes it $3\frac{5}{8}$ in. total length. With this held fairly tightly in the S.C. chuck (not running more than ordinarily truly, but the truer the better), load the large end, at first thinly, with flour emery or carborundum, applied with thin oil. This should just pass into the cylinder with the lathe not running, and having the tube thus on the lap, start the lathe running fairly fast, and, holding the cylinder by hand, work it along the lap backwards and forwards with the acting head passing out at both ends. So soon as it runs easily, stop the lathe and recoat the lap to pack it, and continue. This will result in a fine finish with somewhat coarse polish. To finish polish, clean the lap of abrasive as much as possible, and replace it with Cornish silica (as used in liquid metal polishes) culled from the bottom of liquid empty, but otherwise clean polish tins. This applied in the same manner with oil should (in the absence of any grit or dust) put on a very fine velvety finish. This operation is only likely to be successful if no aggressive striations occur in the bore.

The Plunger

Referring now to the plunger, the method of turning is so obvious that no description is needed. The piston head is, in the first case, fine finish turned dead parallel and of a size to just enter the bore. It is then fitted with a lead or hardwood bored washer, about $\frac{1}{2}$ in. thick. A 5/16-in. clearing hole in a square piece of hardwood $\frac{1}{4}$ in. thick should do. Load the latter with Cornish silica and oil in the bore ; hold the job in the chuck, as described for the cylinder wood lap, projecting about 1 in. and put the ring lap right on to it before starting the lathe. Proceed in the same way as described for the cylinder till the piston (when quite clean) goes in the clean bore, with oil, a fairly tight fit. Mr. Willoughby suggests that the cylinder and its plunger may be lapped together, but, if this be done, do not use emery or carborundum. In order to attain a velvety fit by interlapping use very little clean Cornish silica with thin oil, cleaning both with petrol or benzine (sufficient can be procured in a small bottle as lighter spirit) between each test for fit. The silica does not appear to bury in the softer surface as do emery or carborundum. A note will be given at the end on the matter of making and fitting a packing ring.

If any trouble occurs as to maintaining cut with wood laps, by reason of rapid wear : if the cylinder lap be diametrically sawn down through its effective length with a fine hacksaw or fine slitting saw and fitted with a metal wedge (such as a piece of thicker hacksaw blade ground slightly wedge shape on each side) it can be set again into cut by slightly driving the wedge in the saw cut. And also, if a wood ring lap gives the same trouble, slit it radially across the grain and then by putting slight pressure with the fingers on the sides parallel with the saw cut, it can be put into effective cut again.

Cylinder Covers

The turning and screwcutting of the top and bottom covers of the cylinder need little comment, except to point out that the top cover should be made from a piece of 7/16-in. hexagon brass, and should be screwcut, shouldered and bored in the same setting to ensure concentricity. The bottom cover needs only to be oil-tight and Mr. Willoughby directs in his drawing that the driver slot should be made double in the form of a cross, presumably to provide oilway to the suction-valve.

The filler socket can be turned from a piece of $\frac{7}{8}$-in. round brass, using about only $\frac{3}{8}$ in. of it ; and the plug, which must be turned and fitted a nice push-fit, almost a snap, from a piece of $\frac{5}{8}$-in. round. The compression spring, which should be about 2 in. or a little more in length when stretched to normal, should be made to clear the plunger rod freely when so extended, and then in no part of its action will it seize the rod. The stroke of the plunger closing the spring up is about $1\frac{1}{8}$ in. ; if more stroke be needed the top of spring can be buried in a recess in top cover, but to render it effective, it must be stretched a little in normal length, but so as not to seize the rod.

It may be asked now how to construct and fix the fittings to the tank. As shown, it is as Mr. Willoughby shows it, made in sheet copper and presumably soldered together. In any case, a little later the writer will give his proposals for making the tank in sheet tinplate.

(To be continued)

A Small Bevel-gear Shaping Machine

Designed by T. P. S.

THE reproduced drawings (on the following two pages) show a design for a small hand-operated bevel-gear shaper with a capacity of from 3 in. maximum to $\frac{7}{8}$ in. minimum diameter mitre and 3 in. × 1 in. diameter of bevel gears (3 : 1 ratio).

Main Slide

This carries a 3/16 in. square tool with a stroke of $\frac{3}{4}$ in., and is adjusted for position by means of the slotted links to suit the diameter of the blank to be dealt with.

Tool Slides

The front of the main slide is fitted with a small tool slide with vertical and horizontal movements which enable the tool to be adjusted to the correct position.

(To keep down the overend projection of the tool from the main slide these two slides are on the half-nut principle described in THE MODEL ENGINEER of 22nd and 29th June, 1939, issues, in the article on "A Turret Head"; both half-nuts are in the horizontal slide.)

Tools

One tool is required for the faces of the teeth; it is shaped like a blunt U.S.A. screw-cutting tool having its two sides at an angle of 40 deg. (one rack tooth in fact), the point width should be appreciably less than the width at the bottom of the tooth space at the small end of the gear to be cut, and it should project below the cone apex point a distance equal to the dedendum at the small end.

Two tools (right- and left-hand) with vertical cutting edges are required to finish off the flanks; the points of these tools should be set on the horizontal line through the cone apex point, and the index reading noted as the vertical slide is used for the feed in this case.

These tools are set by means of the gauges shown on Fig. 5, which shows the setting for one side of the space; for the other side the gauges are changed end for end.

Cross-slide

The main slide works in vee guides on a cross-slide which is pivoted on a pin fixed in the baseplate; the cross-slide is capable of being traversed by the feed worm in an arc of 15 deg. each side of its central position across the baseplate.

Locating Pin

This is used to lock the cross-slide in its central position; that is, when the line of stroke of the tool is at right-angles to the centre line of the blank frame pivot pins; it is removed when cutting the faces, but is put in position when changing from one tooth to the next and when cutting the flanks.

Blank Frame

Mounted on the baseplate are two standards carrying the pivot pins for the blank frame; this frame is fitted with a turntable having a central bolt on which the blank to be cut is mounted, together with suitable distance-pieces for height and a bush for the bore; the frame is adjusted round its pivot pins by the indexed worm in order to bring the pitch cone line of the blank parallel with the line of stroke of the tool when cutting the face of the tooth; also, to bring the bottom of the tooth space parallel with this line when cutting the flank.

As the pitch of the teeth of the worm rack is 0.1 in. (or 180 teeth in the complete circle) one half of a revolution of the worm moves the frame through 1 deg., and each division of the indexed hand-wheel indicates one minute of arc.

Turntable

This is rotated by the worm carried by the blank frame; at one end of the worm shaft is a conventional division plate, and since the faces of the teeth are not finished simultaneously, the division plate must have such a number of holes that is an even multiple of the minimum number of holes required to suit the number of teeth to be cut; the holes half way between those used for the first face being used for the second.

The other end of the worm shaft is fitted with a friction coupling which is engaged only when cutting the tooth faces when both the tool and the blank are being rolled simultaneously by the feed shaft, as they are then coupled through the two worm shafts and the mitre, bevel and spur gears.

(The index pin is, of course, disengaged during this operation.)

NOTE.—The centre of the cross-slide pivot pin, the blank frame pivot pins, the main and cross slides and the face of the turntable all cut one another at one point, which will then be the apex of the pitch cone of any wheel to be cut.

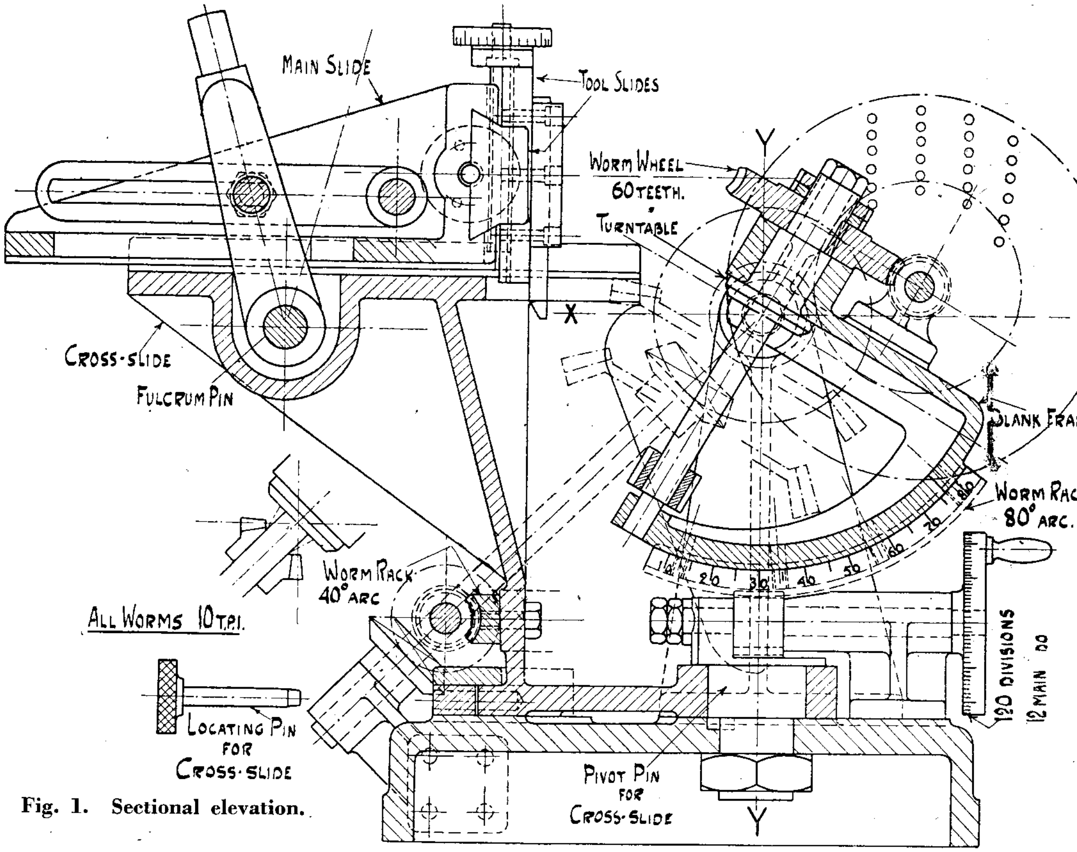


Fig. 1. Sectional elevation.

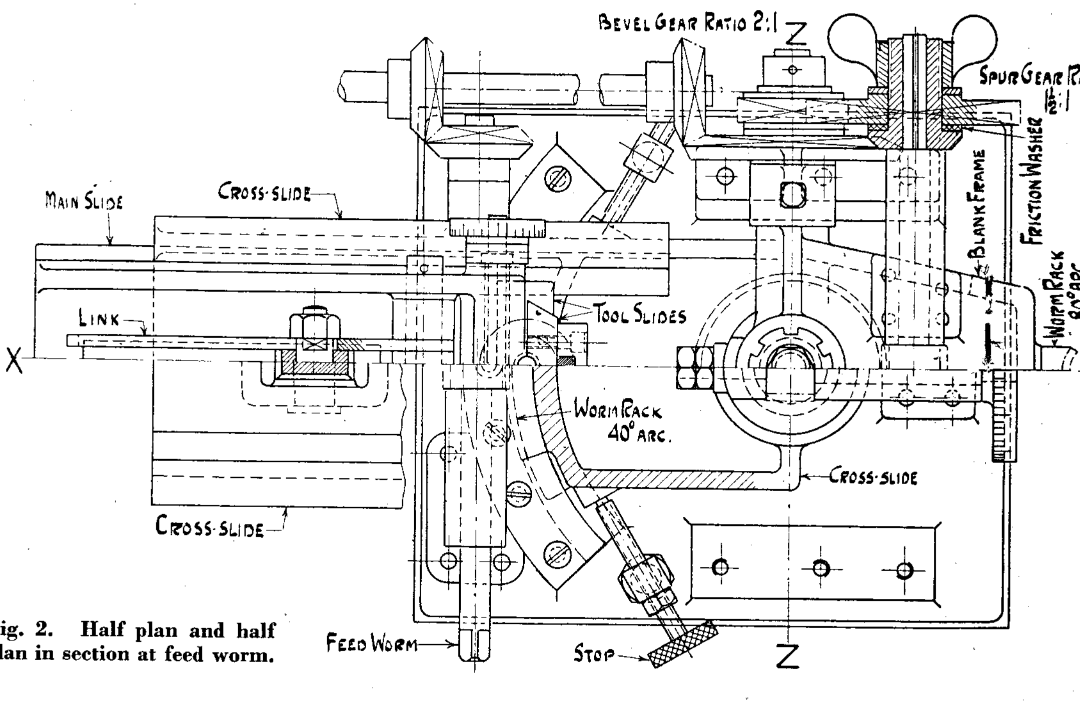
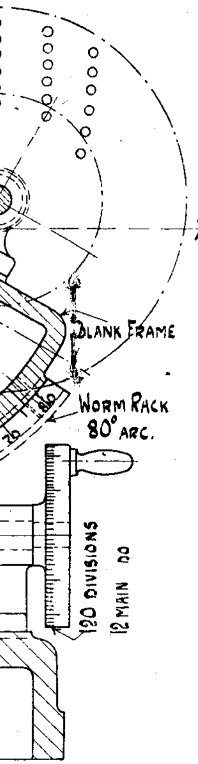
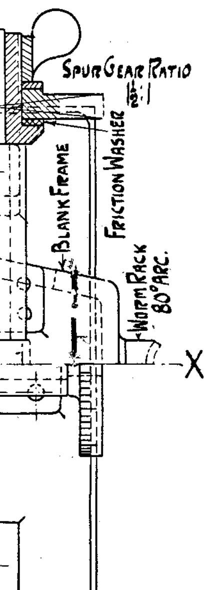


Fig. 2. Half plan and half plan in section at feed worm.





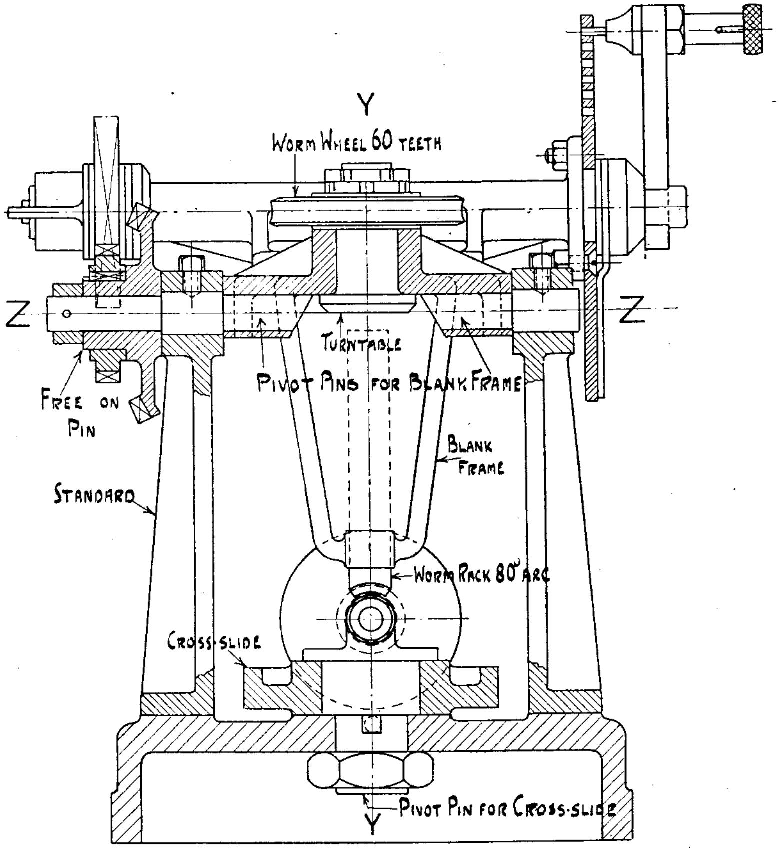


Fig. 3. Sectional end view of blank frame, etc.

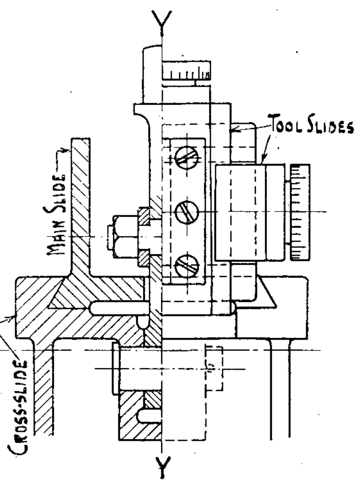


Fig. 4. Half section through fulcrum pin.

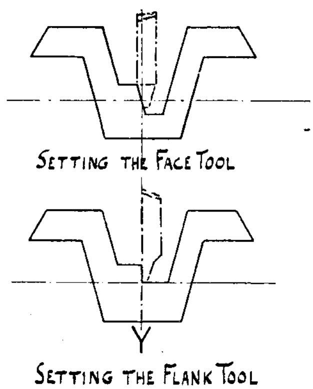


Fig. 5. Gauges for setting tools.

Looking after Workshop Tools

By A. J. T. EYLES

THE maintenance of tools used by the model engineer is of great importance, because good tools are not only expensive, but they will not produce good work unless they are kept in a first-class condition.

Oilstones should be properly cared for to retain the life and sharpness of the grit—to keep the surface flat and even—and to prevent glazing. New stones should be soaked in oil for twenty-four hours before using, and the stone must be kept slightly moistened and perfectly clean. If an oilstone is kept in a dry place it should be kept in a closed box and a few drops of clean oil poured on it.

A Problem

The levelling of oilstones to remove the hollows caused by continued use is a problem which has doubtlessly confronted many model engineers. Grinding on an emery wheel tends to glaze the surface and destroys the cutting qualities of the oilstone. One good method is as follows : Fix an old 14-in. bastard file on the bench and pour a small quantity of oil and put some coarse emery on it. Then well rub the stone to and fro over the file with a slight pressure until the surface of the stone is level. Another good method is to take a cast-iron block that has been planed smooth, and lightly sprinkle it with No. 90 abrasive. The faces of the oilstone are then levelled by rubbing them over the block and applying the abrasive as needed, until the stone is levelled.

Sharpening Tools

When sharpening tools on an oilstone a mixture made from three parts glycerine and one part alcohol will be found better than the lubricating oil usually used.

Always keep an oilstone clean and wipe off all dirty oil as quickly as possible after use, as this prevents the stone from absorbing fine particles of dust and grit, and also helps to retain the cutting qualities.

Not infrequently one sees in the workshop several files lying about worthless because they have become clogged with grease, dirt or metal. These files have been found to either glide over or scratch the model work, and have consequently been discarded. When files are clogged with dirt, grease, solder, aluminium, or similar metal, they should be cleaned and made fit for further use. This cleaning can be done by boiling the files in a caustic soda solution. Ten per cent. to 15 per cent. of caustic soda is found to give good results. After the cleaning treatment, rinse in water, and rub the teeth with a file card. If the file teeth are clogged with brass, bronze or copper, first treat as described above, then immerse in an acid solution composed of hydrochloride acid one part, nitric acid two parts, and water seven parts. A final wash in the soda solution is desirable to neutralise the acid treatment, and then dry with heat. For protection against corrosion, rub the file teeth with an oily rag.

Care of Files

Care should be taken when laying a file down or when putting it away that its teeth do not come forcibly in contact with other steel tools, as its teeth are liable to get broken, in which case the time occupied on the next filing job will be considerably longer and less efficiently performed in proportion to the number of damaged teeth.

When files are kept in a drawer they should be separated from each other by low partitions and arranged according to length, section-cut and condition, thereby facilitating the selection of any desired file when required for use. The model engineer should at all times exercise good judgment in the selection of the proper file for the job in hand, otherwise he cannot expect to get the best results from the files he uses.

Cutting Tools

Lathe cutting-tools should always be maintained in proper condition. A dull or improperly formed lathe tool will not do satisfactory work and is often the cause of injury to the user or accident to the model component. Never use tools (chisels, punches, etc.) which have burred or " mushroom " heads, or any tools with loose or defective handles. Tools with these ragged edges should be properly trimmed, and the tool handles should be either renewed or properly secured. Many engineers have lost the sight of an eye by being struck with a bit of steel broken from the head of a cold chisel, set punch, or other percussive tool. If the battered, ragged heads of these tools are ground off regularly, or trimmed as above mentioned, the chance of steel flying off and causing accidents will be practically eliminated.

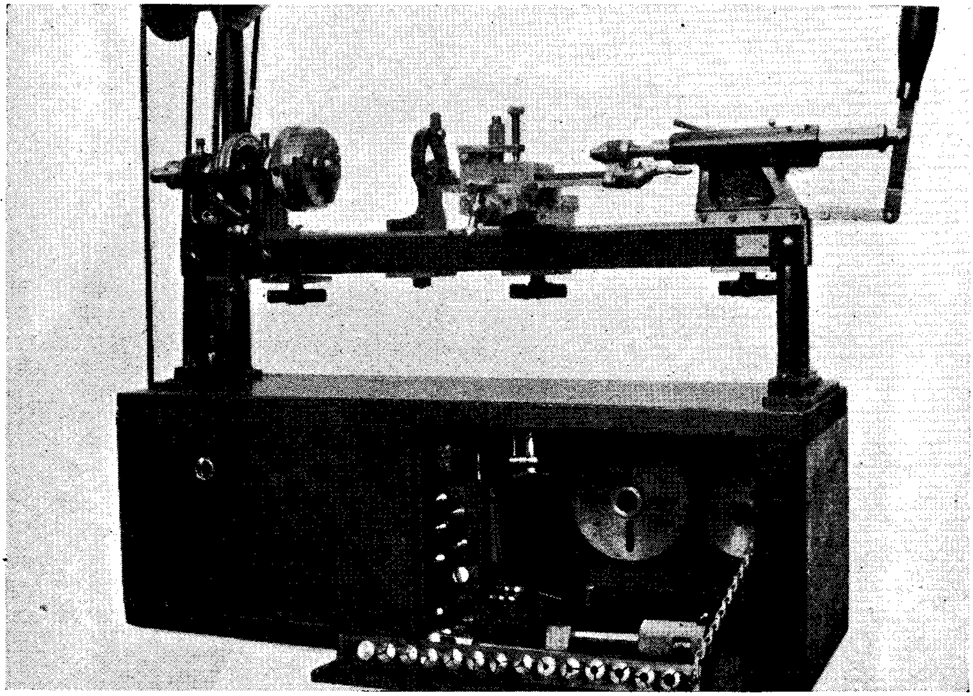
A SMALL PRECISION LATHE

THE photograph reproduced below is of a small (60 mm. centre) precision lathe I have completed. It is built up entirely of steel sections welded together ; the only bought components are the motor and three-jaw chuck.

The headstock is fitted with double cones of the Lorch style, while the slide-rest and tailstock are a rough copy of the Boley.

The collets are all hardened. The lever can be taken off at the tailstock and a screw fitted in its place.

It turned out to be a really accurate and handy tool, and my employers offered to buy it from me, but I wanted it to make baby injectors on !—D. J. UNWIN.



Don'ts for the Model Engineering Beginner

Here are a few more " Don'ts " following on those given on page 228 in the September 3rd issue.

Don't forget, before tapping a hole, to make sure that your tap carries the same number of threads per inch as the screw or bolt.

Don't take an intricate piece of model work apart without marking each piece to show how it goes back correctly.

Don't put a nice piece of finished model work in a vice without using suitable clamps made from soft metal—aluminium, copper or zinc.

Don't attempt to solder metal model parts until they have been made perfectly clean, as solders adhere only to bright and clean surfaces.

Don't use one kind or brand of soldering flux for all metals, as the flux selected should be determined by the nature of the work.

Don't waste the soldering flux by putting on parts where you do not wish the solder to adhere.

Don't ever fail to get the very best solder for model making.

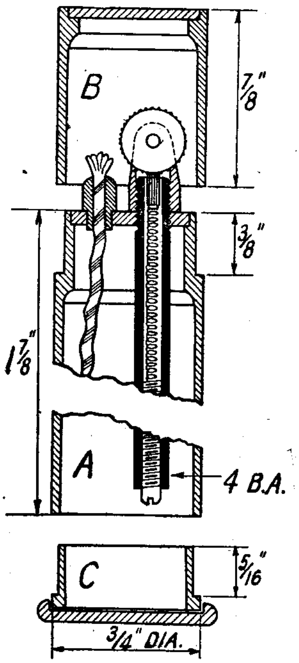
Don't forget it is necessary to use the soldering iron (copper bit) so that its point or slopes remain tinned ; retinning involves loss of time and frequent filing quickly wears it away.

Don't forget that all sheet metal soldered joints should be kept under slight pressure until the solder has set, thereby preventing disruption of the joint.—A. J. T. EYLES.

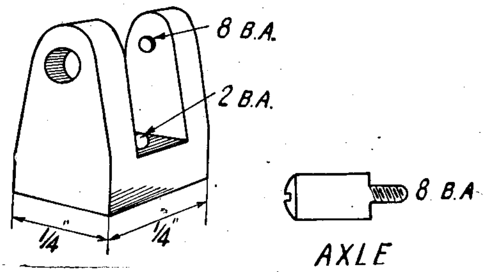
A Cylindrical Petrol Lighter

THE principal advantage of making a petrol lighter of round tubing is that all the work of making it can be done on the lathe. The only hand-fitting to be done is that of cutting the slot for the striker wheel, thus the article is quickly made. The material used consists of odd ends of the thick-walled brass tubing used by the plumbing trade, the $\frac{3}{4}$-in. diameter size in this case.

Sizes are given in the sketch for guidance, but may be altered to suit material on hand. The piece chosen for the body (A) is placed in the chuck and turned down on the outside until the tube is about half its former thickness for a distance of $\frac{3}{8}$ in. and the small rebate, about 1/16 in. deep, is formed on the inside. The tube is then reversed in the chuck and bored out with a round-nosed tool as shown. The cap (B) is also bored out in the same way so that it becomes *an easy friction fit* on the turned portion at the top of the body.



The discs which fit in the top of the body and cap are turned by soldering the blanks to short ends of rod or tube so that they can be chucked for turning, the blanks being 1/16 in. thick. The blank for the base is turned in the same way, but is $\frac{1}{8}$ in. thick and is, if possible, knurled on the outside. The bottom cap (C) should be *a tight friction fit* in the bottom of the base. The wheel is $\frac{3}{8}$ in. diameter by 5/32 in. thick and is made from mild-steel by one of the methods already described in this journal, and is then case-hardened with "Kasenit." The detail of the wheel-holder and flint-tube will be obvious from the sketch, but it should be noted that this construction permits a close

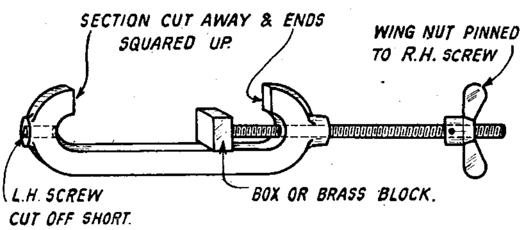


adjustment of the flint to the wheel. When this adjustment has been made, the striker assembly, wick-holder and disc are placed in the top of the body and the whole secured by lightly sweating with solder. The other discs are also secured by sweating from the inside. The case is, of course, loosely filled with cotton-wool or waste before use.—H. H. WARD.

An Improvised Cee Clamp

Having to do a job which needed the use of a standard cee clamp, and not having one handy, pushed the writer to the following improvisation.

A $\frac{3}{8}$-in. turnbuckle of galvanised steel—a relic of the last war—was treated to a slight operation in the form of cutting off the



left-hand screw close to the buckle, and fitting a wing-nut to the right-hand thread.

One side of the buckle was cut away and cleaned up, and faces squared up at each end. A small block of brass or box-wood was inserted over the end of the screw to stop marking the article clamped.—F. C.

★ Improving the Two-Stroke

A 30-c.c. Racing Engine Design

By EDGAR T. WESTBURY

THE material recommended for the flywheel (Fig. 127) is mild-steel, if it is possible to obtain a suitable blank, or a slice cut off a bar of suitable diameter. But if this is not available, a casting may be used, though it is most important that the metal from which it is made should be homogeneous and of sufficiently high tensile strength to withstand the bursting stress caused by centrifugal force at very high speed. According to authorities on strengths of materials, cast-iron is not a safe material to use for a high-speed flywheel, but it is very commonly employed for this purpose on small petrol engines, and in spite of the high speeds attained, I have yet to hear of one bursting. The eventuality, however, is one which is not lightly to be regarded, and many constructors will undoubtedly prefer to play safe in this respect. Bronze, or good quality gunmetal, has a higher tensile strength than ordinary cast-iron, and has the further advantage of a higher specific gravity, so that for a given weight and diameter, it would be capable of storing more kinetic energy (momentum) than iron or steel. A composite or built-up flywheel may be worth considering as a means of utilising available material; the important point in this case is that the method of fabrication, no less than the strength of the actual material, should be fully adequate in every way to withstand the centrifugal and torque stresses.

In the machining of the flywheel, only two factors are of really vital importance: namely, the fit of the bore on the taper of the crankshaft, and the concentric truth of all surfaces about the running centre. Dimensions are relatively unimportant; if there were no limiting or restricting factors, it would be profitable to increase the diameter well above that shown, and in any case it is not desirable to go very much below it. The reason for bevelling the edge of the flywheel has already been explained; most racing engines have their shafts inclined in the hull at an angle of about 10 to 15 deg. to the floor surface, and by bevelling the flywheel at the same angle it is possible to set the engine lower than usual, thus also lowering the centre of gravity of the whole installation. Also, it will be noted that the absence of the usual starting pulley on the outside of the flywheel, which in turn obviates the need for clearance room for applying the starting cord or belt, makes it possible to bring the engine very close to the step (assuming that the form of hull renders this desirable) and thereby puts the centre of gravity of the plant farther aft.

If the flywheel is made from a casting, the procedure which will be found most satisfactory will be to rough-machine it all over in the chuck and then mount it on a true taper mandrel for finishing. The chuck offers the best means of support for the heavy cuts

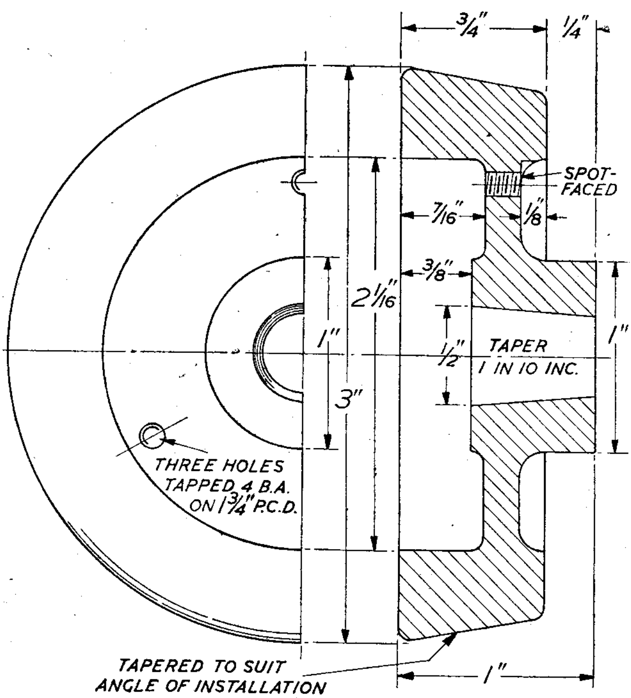


Fig. 127. Flywheel.

* *Continued from page* 308, "*M.E.*," *September* 24, 1942.

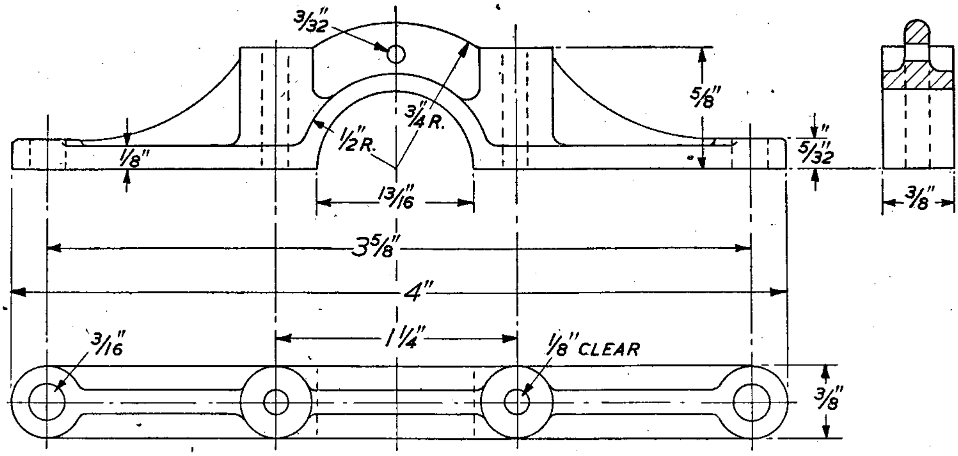


Fig. 128. Saddle bearer.

necessary to remove the hard skin, but the mandrel ensures positive concentric accuracy of the finished component.

Chuck the casting first by the inside of the rim on the near side; this will enable the hub boss to be faced and turned, the front recess and rim face, also the outer diameter to be rough-machined. Then reverse the work, and machine the rest of the outside surface, and at the same setting drill and bore the centre to fit the shaft. The machining on this side may be finished outright, because there should be no possible doubt of it being perfectly true with the bore if ordinary care is observed in machining the latter.

Mating Surfaces

I have on several previous occasions given hints on fitting internal and external tapers, so that it is hardly necessary to deal in detail with the boring and fitting of the flywheel; but at the risk of wearying the reader with my incessant repetitions of " highly important " and " vitally essential," I will again emphasise the need for the mating surfaces to fit closely all over the area of contact. Many readers complain to me about flywheels which persist in coming loose, even though forced on with such force that the hubs nearly burst, or the threads on the shaft or in the nut approach the point of stripping; I assure them that the one and only remedy is to make them fit properly on the tapers. And this can only be done by careful machining, not by any process of lapping or grinding in; it is not so much a matter of skill as of patience and perseverance.

One other point about the fitting of the flywheel on its shaft should not be overlooked; that is, the end location, or the position relative to the length of the shaft when it is fully tightened up. This should be such that there is very little or no end clearance between the hub boss and the end of the main bearing. It may be difficult to gauge this exactly when machining, but it is permissible to correct errors in this respect either by taking a skim off the end of the housing or the boss, or by inserting a thin washer between them.

Having machined the bore and back surface, a mandrel should be made having a taper and thread similar to that of the crankshaft, and the wheel mounted on it for truing up the rest of the surface. The crankshaft itself might be used for a mandrel, but there are several reasons why it is undesirable to use a finished component for such purposes, and it does not take long to make a suitable mandrel, anyhow. Finish off the surfaces of the flywheel as smoothly as possible, and round off the corners to a slight radius.

Three holes are drilled through the web of the flywheel and tapped 4 B.A. to take the pivots of the starting pawls. The faces of the holes should be spot-faced on the outside to form a true seating for the pivot lock-nuts; this is preferable, on the grounds of mechanical strength, to the more obvious procedure of turning a sharp internal corner in the recess, to provide clearance for the nuts.

Saddle Bearer

This component, shown in Fig. 128, should be made from an aluminium casting, for preference, though it would be possible to machine from the solid, or build up in any convenient manner, a part which would fulfil essential purposes. The machining is carried out in conjunction with that of the cap, shown in Fig. 129, which, after the two

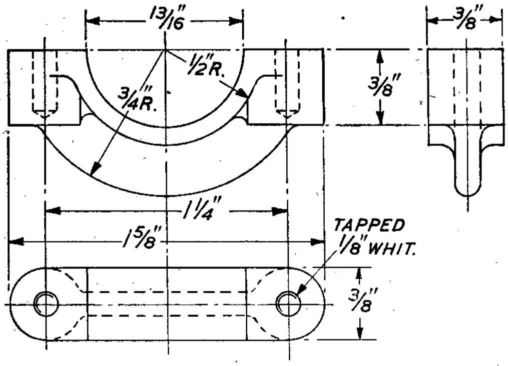


Fig. 129. Cap for saddle bearer.

parts have been trued up on the joint faces, is clamped or bolted in its proper relative location, so that they can be bored and faced as a single unit.

First, the saddle bearer is held crosswise in the four-jaw chuck, with the underside outwards, and this surface set parallel with the chuck face. It is then machined with a facing tool to bring the extended arms to the correct thickness. The cap is then similarly mounted, and faced up in the same way. Mark out the holes in the bearer for the two clamping screws, and after drilling the holes, clamp the cap thereto by means of a small vice or other convenient method, so that the tapping holes in the cap can be spotted through with a drill point from those in the bearer. Drill and tap these holes and secure the parts together by means of temporary screws.

The assembly is then set up in the four-jaw chuck so that the centre can be bored out to fit over the nose of the main bearing housing. It is very important that the joint face should be exactly square with the chuck face, which may be checked by means of a square on the extended arms; also, that it should intersect the centre of the bore, which can be ascertained by a scribing block set on the cross slide, with the scriber point exactly at centre height. In order to eliminate the effect of any possible error in the scriber setting, the work should be tested in one position, and then rotated half a turn and tried again; the difference, if any, being split.

Bore out the centre to a tight push-fit over the nose of the main bearing housing and face it both sides. The best way to face the reverse side is to do it at the same setting by means of an internal recessing tool, but if this is not available, the work may be removed and mounted on a mandrel for the operation.

The two holes for the holding-down bolts are drilled in the extremities of the arms at exactly equal distances from the centre of the bore, and all four holes in the bearer should be spot-faced. It will be seen that a 3/32-in. hole is drilled through the web of the bearer, over the centre of the bore; the object of this hole is to anchor the return spring of the starter drum.

In order to ensure that the bearer will clamp tightly on the main bearing housing, the joint face of the cap should be slightly eased off; rubbing it down on a sheet of emery-cloth should be sufficient if the bore was machined to a good fit. Another way in which the desired result might be achieved would be by interposing paper shims between the bearer and cap during the boring operation, and removing them afterwards. It is not desirable to allow a large gap between the two parts when they are clamped together, as this may introduce a tendency to distort the bearing housing.

Resilient Mounting

Some constructors may wish to try out the idea of resilient mounting for the saddle bearer, which might be beneficial in certain circumstances. This can be done by boring the bearer out to a larger diameter and interposing a rubber sleeve between the bore

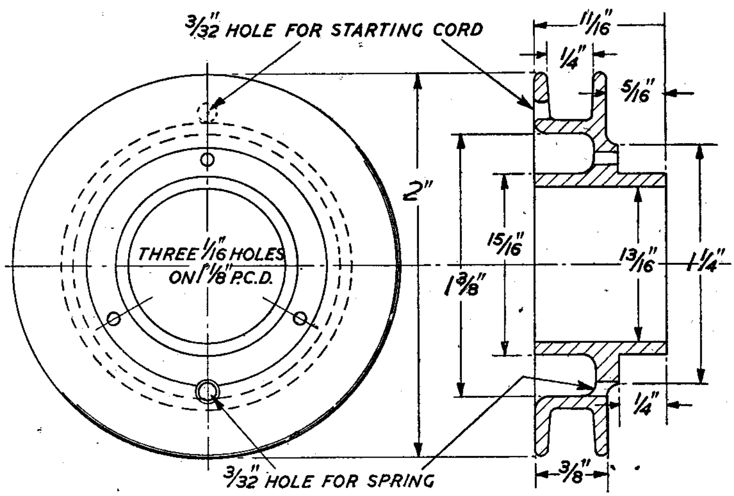


Fig. 130. Starter drum.

and the housing. "The "horns" of the two half-bearings will have to be relieved so that they do not pinch the sleeve up into the joint. Resilient mounting is favoured in automobile practice to prevent vibration being transmitted from the engine to the chassis, but I am not certain that there is much advantage in it for model boat work. I have not found that the vibration of a well-balanced engine affects the boat structure to any marked extent, neither have I worried much about the comfort of the passengers (mostly moths and earwigs) !

Rubber washers above and below the arms of the main and saddle bearers would contribute to resiliency, but may affect the alignment of shaft couplings, whereas the rubber sleeve would tend to centre the main housing automatically, however tightly it was compressed by the clamping screws of the saddle bearer.

Starter Drum (Fig. 130)

The most suitable material for this part is a hard aluminium-alloy such as Duralumin, but if this is not available, it may be made from a good aluminium or gunmetal casting, or from brass or mild-steel round bar. The main disadvantage of ordinary aluminium is that it would form a very poor bearing metal in contact with the aluminium main bearing housing ; for this reason, some advantage might be gained by making the drum in two parts, comprising a flanged steel sleeve, attached by riveting to an internally-flanged drum. The bearing here does not have a very exacting duty, as it should not be necessary to rotate the drum very long or very rapidly to start the engine at any time, but it gets a pretty heavy loading while a beefy power-boat exponent is on the other end of the starting-cord !

Machining the Drum

No special problems arise in the machining of the drum, which should be carried out as far as possible at one setting, and then reversed and mounted on a mandrel to finish the rest. The rear side should be tackled first, so that ready access can be obtained for machining the recess in the face, which would be awkward to get at with the work on a mandrel between centres. This operation may call for a special tool, something like a parting-tool, with ample clearance on both sides and the corners rounded off. It should not be made the full width of the recess, as it will cut much more fully if made narrower, and traversed sideways as it is fed in.

At the same setting, the bore of the sleeve may be machined to a close running fit on the nose of the main bearing housing, and the groove turned in the outside. It will probably be possible to use the same tool as that used for forming the recess, for this operation, but it should be noted that the sides of the groove are tapered slightly, which may be effected by setting the tool obliquely to deal with each side in turn, or using a tool with a tapered nose. (I used the same tool as that employed for forming the cylinder fins.) The exact amount of taper is unimportant ; its object is simply to enable the mouth of the groove to be kept as wide as possible, without unduly weakening the rim as a whole. Round-off the edges of the rim and clean up the exterior surfaces.

The rest of the machining, which is carried out on a mandrel, may be left until the ratchet wheel is made, so that it can be fitted to its seating with the minimum difficulty.

Ratchet Wheel (Fig. 131)

This may be made either in mild-steel and subsequently case-hardened, or in tool steel, but in the latter case, it must on no account

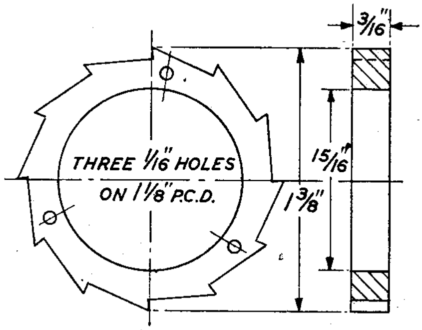


Fig. 131.—Ratchet wheel.

be left too hard, or it may chip or split in the course of the hard usage it will eventually receive. With ordinary methods of tempering, it may be found rather difficult to ensure perfectly even hardness of all the teeth, and in the circumstances, quenching out in oil, without subsequent tempering, may be found best. In the manufacture of parts of this nature, the use of quenching-steel is generally found preferable to case-hardening, but I imagine that "straight" carbon-steel is less likely to be used than one of the tougher alloy steels. However, I have obtained quite good results with ratchet wheels made in mild-steel and case-hardened with "Kasenit" and similar preparations, so long as they are frequently examined, and replaced if there is any sign of the hard case being chipped away or worn through.

(To be continued)

Tell us about your Model!

A plea for wider model engineering publicity, and some hints on how to write up an article for the "M.E."

By E. T. WESTBURY

NEARLY all phases of model engineering activity have been dealt with at various times in THE MODEL ENGINEER—the construction of every type of model, from the drawing-board stage onwards, to its finishing, painting and testing, its running and maintenance, preparation for competition or exhibition, and so on. But so far as I am aware, little or nothing has been said on how to put the description of a model on paper so that the interest and instruction which it has afforded to the constructor and his friends may be extended to a very much wider circle of the model engineering fraternity. There are, no doubt, some readers who will consider that the subject of writing articles is outside the scope of THE MODEL ENGINEER, which is concerned with practical matters, and has little space to spare for a discussion of journalism or literature, but as I shall try to show, the publicity side of model engineering is one which has been sadly neglected, and there are very sound reasons why readers should give the matter serious consideration.

A British Failing

One of the failings of the British, as a race, is that they are not adept or enthusiastic at "telling the world" of their achievements. I use the word "failings" deliberately, because I have, after mature consideration, come to the conclusion that the kind of modesty which consists of hiding one's light under a bushel is certainly not a virtue. The man who is always blowing his own trumpet is liable to become very unpopular, but so long as he has a real tune to blow on it, he is doing no harm, and may possibly do a great deal of good for himself and his fellows. Empty boasting is quite another matter; but in a sphere in which practical proof of every statement is always demanded, the boaster does not last very long. If one really has something to tell or show the world, it is a sin to keep it hidden. Poets may sing of the virtues of the blushing violet—the reward for whose modesty is often merely to be trampled underfoot—but the gaudy and ostentatious hollyhock has brightened many drab lives, and brought life and colour into a monotonous landscape.

"Decadent"

In a world where moral and practical values are rarely seen in true perspective, it is often only too true that "those who shout loudest get most"—in other words, those who fail to call attention to themselves or their works are pushed into the background and forgotten. I am personally convinced that the failure of the British people to propagandise their achievements in the past has often caused the world at large to regard us as unprogressive, unintelligent and even "decadent," whereas the fact is that we are at least as far ahead in every really intellectual field of human endeavour as the "super" races which have systematically boosted their national stock for the last hundred years. It is only recently that we have recognised the actual *necessity* for a national propaganda movement; I believe that if we had realised it long ago, this war would never have happened.

A Parallel

But my purpose is not to discuss international politics, and the only reason for mentioning this is to point the parallel between such matters and the affairs of model engineers. The latter, as a class, are phenomenally shy and retiring over their achievements, and if you doubt this, take notice the next time you call on a friend and ask to see the new model he has made, or is making—he will produce it with an apology, and be most reluctant to make any claim as to its merits. The result is that model engineers are generally regarded as schoolboys who have never grown up, and still play with "toys"—the public have never grasped the underlying fact that the construction of these despised "toys" has called for the most skilful and painstaking craftsmanship, to say nothing of a much higher level of intelligence than is called for in most hobbies or physical pursuits. Whoever heard of an angler who was apologetic, or reluctant to talk, about the one that "just got away"—or the golfer about the hole that he "did in three"? It just simply isn't done—and yet the model engineer, who really has much more to shout about, because his efforts are truly creative, allows the world to forget this fact, and to catalogue him among the "harmless cranks."

Terrified!

I get around a good deal among the model engineering clubs in various parts of the country, besides meeting many "lone hands" who are working in obscurity, often unsuspected by their own neighbours; and in these excursions, I rarely fail to unearth some piece of work of really outstanding merit, in respect either of workmanship, design or performance. Yet the authors of such masterpieces are almost invariably terrified when I suggest to them: "Of course, you are going to send a description of it to THE MODEL ENGINEER?" (I *never* forget the "of course," because to me it is the most obvious, and indeed essential, thing to do!) I assure readers that it is often the most difficult thing in the world to get model engineers to write an article, or even to allow an article to be written, about their models. But few will disagree with me that it is only by circulating the utmost information about models that we can hope to popularise model engineering; my standard argument to those who do not wish to indulge in publicity is "What would happen to model engineering if every constructor of models kept them a dead secret?"

Ability to Write?

The objection is often raised that the writing of an article calls for a considerable amount of literary ability, but at the expense of getting into trouble with some of my journalistic friends for "debunking" their profession, I will make the statement that this is not essential, or even highly important. Literary ability is certainly a necessity to the writer who has little or nothing to write about—a condition only too frequent in ordinary journalism. But the model engineer never suffers from this handicap, and even though his education may be so primitive that the composition and phrasing are laboured, and the grammar and spelling atrocious—the main thing is that he has a story to tell, of a model he has created, of a feat he has achieved; and that story will emerge, even though told in halting language. The finishing touches, correction of grammar and spelling, and polishing off of rough corners, can be done by the Editorial staff—that is what they are there for, anyhow—so long as the relevant facts are provided. I know from actual experience that many interesting articles which have appeared in THE MODEL ENGINEER have been worked up from a manuscript which looked like a telegram composed to cope with charges of a shilling per letter! I do not mean, however, that this sort of thing should be encouraged; writers should do their best with the manuscript, and should also do their best to produce legible handwriting, as a good deal of trouble and misunderstanding is caused by writing which is difficult to decipher.

Write a Letter

I believe that, many years ago, our worthy Editor recommended that the best way to write an article for THE MODEL ENGINEER is to imagine that you are writing a letter about your model to one of your most intimate friends. This advice, in my opinion, cannot be bettered; the intimate touch is appropriate to a fraternity in which the bond of common interest has on innumerable occasions been proved to be capable of overcoming all differences of class, politics or creed.

Illustrations

A word as to illustrations; these are always interesting and helpful, sometimes absolutely essential. Photographs are valuable, not only for conveying the general impression of the model's appearance, but also for furnishing evidence that it exists as a concrete reality. Exact details of construction are, however, better shown by drawings, especially if these are made in orthographic projection, and dimensioned, or the scale of reproduction indicated. Finished drawings are helpful to the Editorial staff, but by no means absolutely essential, and very rough or elementary drawings have on many occasions been worked up so as to be capable of conveying the desired information. In a few cases, it may be found difficult, or almost impossible, to furnish any kind of illustrations, but if the circumstances justify it, THE MODEL ENGINEER will undertake to make drawings or photographs from the model itself.

Further Hints?

I propose to give some further hints on the matter of writing articles for THE MODEL ENGINEER at a later date, provided that both the Editor and readers consider this subject within the scope of our journal; but in the meanwhile, I hope that my exhortation will bear fruit, and that the hermits of the model engineering world will emerge from their caves to prove that their efforts are well worthy of the notice of the public.

[This is sound advice which should be taken to heart by many, if not all of our readers, but especially the "lone hands." After the war, it will be all the more advisable that as much publicity as possible be given to the work of model engineers. We know that many prisoners of war have taken to model making for the first time in their lives, and their interest must be kept alive when peace is restored.—Ed., "M.E."]

Letters

The "Elizabeth Jonas"

DEAR SIR,—I beg to refer to the concluding paragraphs of the article by Mr. Gauld in THE MODEL ENGINEER of the 17th September, and to state that from inquiries received from time to time it appears that many model makers are under the misapprehension that the Science Museum can furnish plans, etc., relating specifically to a model of the Elizabethan ship *Elizabeth Jonas*. Unfortunately, it is a fact that, so far as is known here, no adequate data exists which would enable a faithful model to be made of this or any other individual ship of the period.

Some years ago, the Museum constructed a model of a large four-masted Elizabethan warship, to which was ascribed the date "circa 1600," using particulars partly derived from contemporary plans and drawings attributed to the master shipwright Matthew Baker, and appearing to date from about 1586, and partly from other contemporary sources, some of appreciably later date. Thus the hull form was based upon Baker's draughts, and one of his coloured drawings furnished the scheme of decoration. A rough sail plan sketched in on this latter drawing, and verified from other sources, supplied dimensions for spars and sails: and yet another source was drawn upon for the sizes of ropes and rigging. The actual scale dimensions of the hull are those of the *Elizabeth Jonas*, and the armament is a mean approximation derived from various lists concerning the same vessel. But the model, although a product of painstaking research, is frankly a composite and remains anonymous; and care is taken that no inquirer after photographs, etc., is allowed to mention *Elizabeth Jonas* without enlightenment.

Yours faithfully,

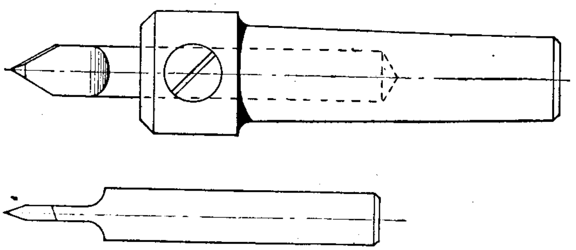
The Science Museum, London, S.W.7.
M. J. B. DAVY, Keeper.

An Improvised Centre Drill

DEAR SIR,—In the paragraph under this heading, in the August 27th issue, "F.C." goes to great pains to devise a tool which is almost useless for its intended purpose. The one thing a centre-drill should *not* do is to leave a "pip" in the centre of the depression which it produces, but that is the very thing this tool is bound to do. It might act more or less efficiently as a countersink, for use in holes already drilled, but is more trouble to make than a simple D-bit, which does practically all that is necessary in this respect.

The end view of this tool shows the cutting edges backed off, which would certainly be most essential, but no reference is made to this in the text, and it would be a rather fiddling job to do. It should further be noted that the angle of the point is too obtuse for use in the normal capacity of a centre-drill, i.e. to form depressions in work intended to be mounted between lathe centres. With these reservations, such a tool might be adapted to serve its designed purpose, by drilling up the centre and fitting therein a small drill point (the broken end of a small twist-drill would serve), but it would be difficult to fix this sufficiently rigidly unless it were sweated in place. It should not project more than about one-third the length of the conical point of the tool.

If one is unable to obtain a proper centre-drill of the Slocombe type, it is suggested that the best tool for centring work is a short and stiff flat "spear-point" drill, fitted to a stub holder tapered to fit the tailstock socket. Such drills are very easily made from round silver-steel rod, which should have the conical point first turned to the correct angle, then filed flat to a thickness of about 1/16 in. for about half an inch or so from the point. The cutting edges are then backed off with a file, and if it is desired to produce a fine-pointed depression, the extreme tip of the cone is bevelled off on the flats so as to run almost to a "diamond" point. Finally, the drill is hardened and tempered to a medium straw colour.



A simply made centre-drill, with taper shank holder for use in the lathe.

If the drill is to be used to form a seating in which to start a drilled hole, the best angle for the spear-point drill is about the same as that of a normal twist-drill; but for centring stock to run between centres, it should be coned to an included angle of 60 deg. The depression formed by the drill should have the centre drilled out with a small diameter drill, so that it clears the point of the lathe centre, and allows the latter to bear on a comparatively large surface. It is most important that the

centre drill should cut smoothly, without chatter, and leave a well-finished hole, otherwise accurate work between centres becomes an impossibility.

The object of these notes is, not to find fault with the above-mentioned contributor, but to assist those readers who find it necessary to make or improvise such tools in these days when it is so difficult to obtain them ready made.

Yours faithfully,
"NED."

There is Hope !

DEAR SIR,—May I, through you, thank Mr. Hornsby for his "friendly dig," but don't let him despair; after this battle is over (and if we are not too old or decrepit to make use of them) there will be plenty of your micrometers and verniers to be had for a "song," as the following story, told to me by one of our leading tool merchants, will go to show.

It seems that at the end of the last war, the gentleman in question used to buy from time to time, quantities of surplus tools from the Government, and at one of the periodical sales at which such tools were unloaded, one lot was described as "Adjustable Wrenches." Apparently, little interest was shown in this lot, and it was knocked down to our friend at a figure which represented something like 1s. 6d. each. When delivered, the "adjustable wrenches" turned out to be Brown & Sharpe vernier slide gauges !

So, when the time comes, keep your eyes open, Mr. Hornsby, and meanwhile, more power to your elbow for so successfully overcoming the lack of any fine tools.

Yours faithfully,
East Horsley. IAN BRADLEY.

Small Cylinder Indicators

DEAR SIR,—Congratulations to Mr. Mayhook for his small steam-engine indicator suggestion.

It tends to avoid the difficulties due to relative volumes of steam and indicator cylinders and the inertia effects present in the usual form of instrument.

Those tempted to experiment with the idea might appreciate some assurance that: the mercury cannot get into the steam cylinder; the meniscus will not change its form during its travels up and down the tube or its position be affected by oscillation due to track irregularities for example.

Assuming the scheme a practical one, the delay in obtaining a diagram could be very tiresome.

"L.B.S.C.'s" methods seem to be precise and practical, and are therefore science at its best. He has frankly told us the state of he art and I believe it is up to us to try and remedy matters for the benefit of those interested. There's good fun ahead if an indicator could show us the way to improve on our mentor's valve settings or achieve like results some other way. To devise a suitable reliable indicator and obtain diagrams of value is no easy task.

Can anyone please state if small-cylinder indicators are an accomplished fact?

Yours faithfully,
Ringwood, Hants. "HEURISTIC."

Clubs

The Society of Model and Experimental Engineers

The Society has accepted an invitation to participate in an exhibition arranged by The Kodak Recreation Society, to be held in The Kodak Hall, Wealdstone, Middlesex, on Saturday and Sunday, 7th and 8th November, 1942. Models and work for exhibition should be delivered to the workshop on Saturday, 31st October, or Tuesday, 3rd November, or they may be taken to the Exhibition on the day of opening. Compressed air will be available for running models, and it is hoped that as many members as possible will loan work, and thereby assist in making the Exhibition a success.

Secretary: H. V. STEELE, 14, Ross Road, London, S.E.25.

Leeds Model Railway and Engineering Society

On September the 19th, Mr. W. D. Hollings gave a fine talk and demonstration on Loco. Boiler Construction. He first described Newcomen's boiler, followed with descriptions of other boilers down to the modern loco. boilers, shown by means of sectional prints and drawings. He followed this with a demonstration of riveting; next a $2\frac{1}{2}$-in. boiler belonging to a member was brazed. Mr. Hollings used an oxygen-acetylene blowpipe, giving demonstrations of copper welding, bronze welding and brazing with Cuprotetic. On October 25th a cinema show will be given by Mr. J. Ely, showing films of our club locos. in action.

Hon. Sec.: H. F. STAINTHORPE, 151, Ring Road, Farnley, Leeds.

NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co Ltd., Cordwallis Works, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer." Cordwallis Works, Maidenhead Berks.